



Future RETI Phase 2 Work by Black & Veatch

Black & Veatch

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Working Group Meeting

September 9, 2009

Agenda

- Review of potential work areas
 - CREZ and Technology Updates
 - Economic Model Update
 - Extended Analysis of WECC Resources
- Discussion of economic model update
- Introduction of out-of-state issues

- Solar

- Update site-specific solar project characteristics for large solar projects that have been moved
- Re-evaluate the assumptions for wet/dry cooling at solar thermal projects
- Update solar profiles to correct truncation issue. Likely to reduce solar thermal CFs by ~8% (e.g. from 24% to 22%)
- Revisit solar technology assumptions (storage for solar thermal, thin film for PV)
- Re-evaluate cost assumptions for solar thermal and solar PV projects

CREZ and Technology Updates

- Geothermal
 - Consider dry-cooling impacts on geothermal output profiles (current assumption is flat)
 - Update geothermal project cost
- Wind
 - Reassess Palm Springs wind resources
 - Reassess Fairmount wind resources
 - Review 12x24 typical output profiles against WREZ and new data
- Reassess need / definitions for sub-CREZs
- Update pre-ID project information

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Economic Model Update

Economic Model Update

- Consider incentives from the American Recovery and Reinvestment Act of 2009
 - Update Canadian/Mexican incentives
- Recalculate base economic rankings
- Re-perform uncertainty analysis
- Reformat overall model to be user friendly similar to the WREZ model (probably long-term)

Cost of Generation Calculator Improvements

- Modeled ITC as a capital cost reduction, not a year 1 windfall
 - More appropriate to reflect ARRA “ITC Grant”
- Allowed for a mix of depreciation schedules
 - Can better reflect tax code and better mimic foreign depr rules
- Included additional revenue streams
 - Allows for more flexibility in modeling incentives
- Modeled performance degradation
 - Previous RETI work included degradation, but now it is modeled explicitly

Cost of Generation Calculator

All inputs are in blue.

Technology Assumptions	
Project Capacity (MW)	1
Capital Cost (\$/kW)	\$2,400
Fixed O&M (\$/kW)	\$50
Fixed O&M Escalation	2.5%
Variable O&M (\$/MWh)	\$0
Variable O&M Escalation	2.5%
Fuel Cost (\$/MBtu)	\$0
Fuel Cost Escalation	2.5%
Heat Rate (Btu/kWh)	0
Capacity Factor	35%
Misc Revenue (\$/MWh)	\$0
Misc Escalation	2.5%
Degradation	0%

Financial/Economic Assumptions	
Debt Percentage	60%
Debt Rate	7.50%
Debt Term (years)	15
Economic Life (years)	20
Percent 5-year MACRS	100%
Percent 7-year MACRS	0%
Percent 15-year MACRS	0%
Percent 20-year MACRS	0%
Energy Price Escalation	2.5%
Tax Rate	40%
Cost of Equity	15.00%
Discount Rate	9.000%

Incentives	
PTC (\$/MWh)	\$20
PTC Escalation	2.5%
PTC Term (years)	10
ITC	0%
ITC Depr Basis	100%

Outputs	
NPV Equity Return	\$0
LCOE	\$84.24

Calculation	
Cap Cost	\$2,400,000
	0
	0 -813493.6209
	5 -755913.816
slope	11515.96099

84.24405168

Year	1	2	3	4	5	6	7	8	9	10	11	12	13	
Annual Generation (MWh)	3,066	3,066	3,066	3,066	3,066	3,066	3,066	3,066	3,066	3,066	3,066	3,066	3,066	
Power Price	\$70.64	\$72.41	\$74.22	\$76.07	\$77.97	\$79.92	\$81.92	\$83.97	\$86.07	\$88.22	\$90.43	\$92.69	\$95.00	
Misc Revenue	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	
Total Operating Rever	\$216,584	\$221,998	\$227,548	\$233,237	\$239,068	\$245,045	\$251,171	\$257,450	\$263,886	\$270,484	\$277,246	\$284,177	\$291,281	
Fixed O&M	\$50,000	\$51,250	\$52,531	\$53,845	\$55,191	\$56,570	\$57,985	\$59,434	\$60,920	\$62,443	\$64,004	\$65,604	\$67,244	
Variable O&M	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	
Fuel Cost	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	
Operating Expenses	\$50,000	\$51,250	\$52,531	\$53,845	\$55,191	\$56,570	\$57,985	\$59,434	\$60,920	\$62,443	\$64,004	\$65,604	\$67,244	
Interest Payment	\$108,000	\$103,865	\$99,420	\$94,641	\$89,504	\$83,982	\$78,046	\$71,664	\$64,804	\$57,429	\$49,501	\$40,979	\$31,817	
Principal Payment	\$55,134	\$59,269	\$63,714	\$68,492	\$73,629	\$79,151	\$85,088	\$91,469	\$98,330	\$105,704	\$113,632	\$122,155	\$131,316	
Debt Service	\$163,134	\$163,134	\$163,134	\$163,134	\$163,134	\$163,134	\$163,134	\$163,134	\$163,134	\$163,134	\$163,134	\$163,134	\$163,134	
Tax Depreciation - 5	\$480,000	\$768,000	\$460,800	\$276,480	\$276,480	\$138,240	\$0	\$0	\$0	\$0	\$0	\$0	\$0	
Tax Depreciation - 7	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	
Tax Depreciation - 15	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	
Tax Depreciation - 20	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	
Taxable Income	(\$421,416)	(\$701,117)	(\$385,203)	(\$191,729)	(\$182,107)	(\$33,748)	\$115,140	\$126,352	\$138,162	\$150,611	\$163,740	\$177,593	\$192,219	
PTC	\$61,320	\$64,386	\$64,386	\$67,452	\$67,452	\$70,518	\$70,518	\$73,584	\$73,584	\$76,650	\$0	\$0	\$0	
Taxes	(\$229,886)	(\$344,833)	(\$218,467)	(\$144,143)	(\$140,295)	(\$84,017)	(\$24,462)	(\$23,043)	(\$18,319)	(\$16,406)	\$65,496	\$71,037	\$76,888	
Total	(\$66,086)	233,337	352,447	236,351	166,462	161,635	165,358	54,514	57,526	58,152	61,312	(\$5,388)	(\$5,583)	(\$5,585)

MACRS Depreciation Schedules													
5	0.2	0.32	0.192	0.1152	0.1152	0.0576	0	0	0	0	0	0	0
7	0.1429	0.2449	0.1749	0.1249	0.0893	0.0892	0.0893	0.0446	0	0	0	0	0
15	0.05	0.095	0.0855	0.077	0.0693	0.0623	0.059	0.059	0.0591	0.059	0.0591	0.059	0.0591
20	0.0375	0.07219	0.06677	0.06177	0.05713	0.05285	0.04888	0.04522	0.04462	0.04461	0.04462	0.04461	0.04462

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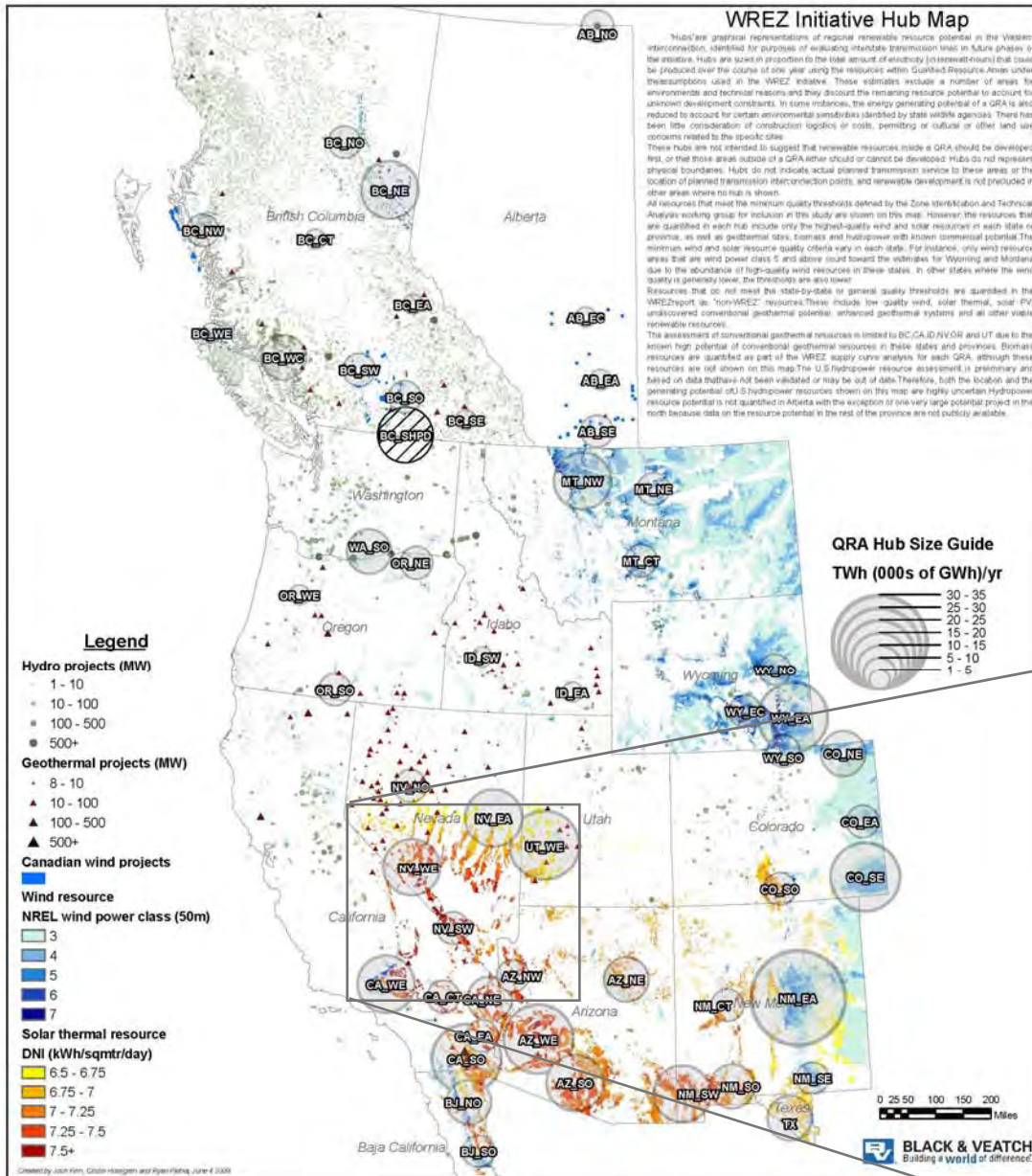
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OOS Resources in RETI

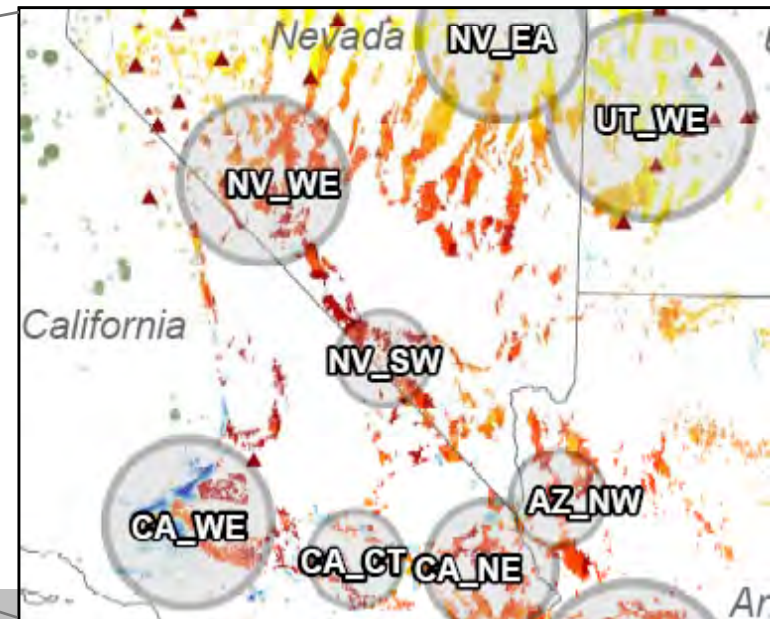
Western Renewable Energy Zones (WREZ)

- High-level WECC-wide analysis of renewable energy zones
- Analyzes cost of transmitting renewables from zones to load centers
- Could augment or substitute RETI out of state resource analysis

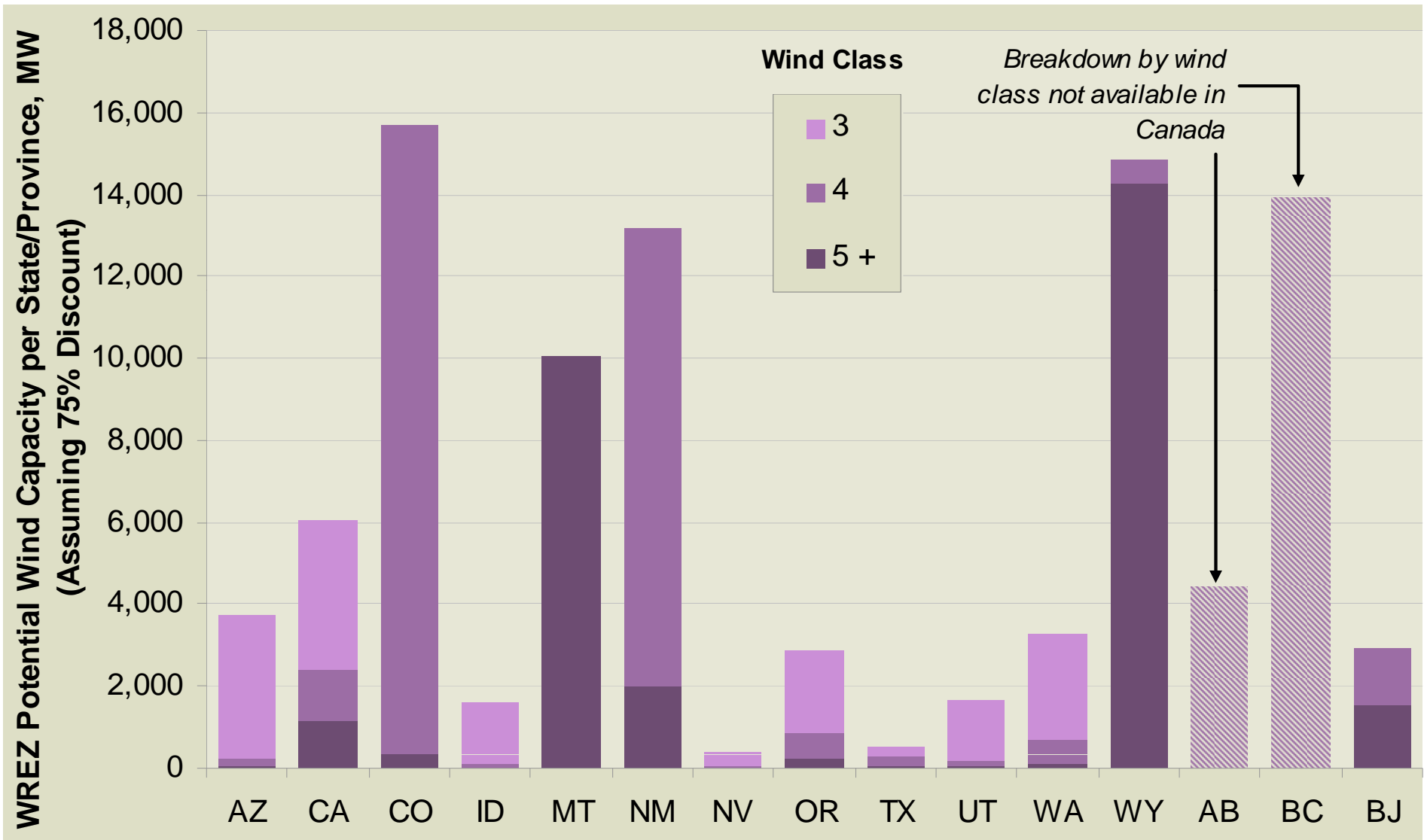


WREZ Resource Assessment

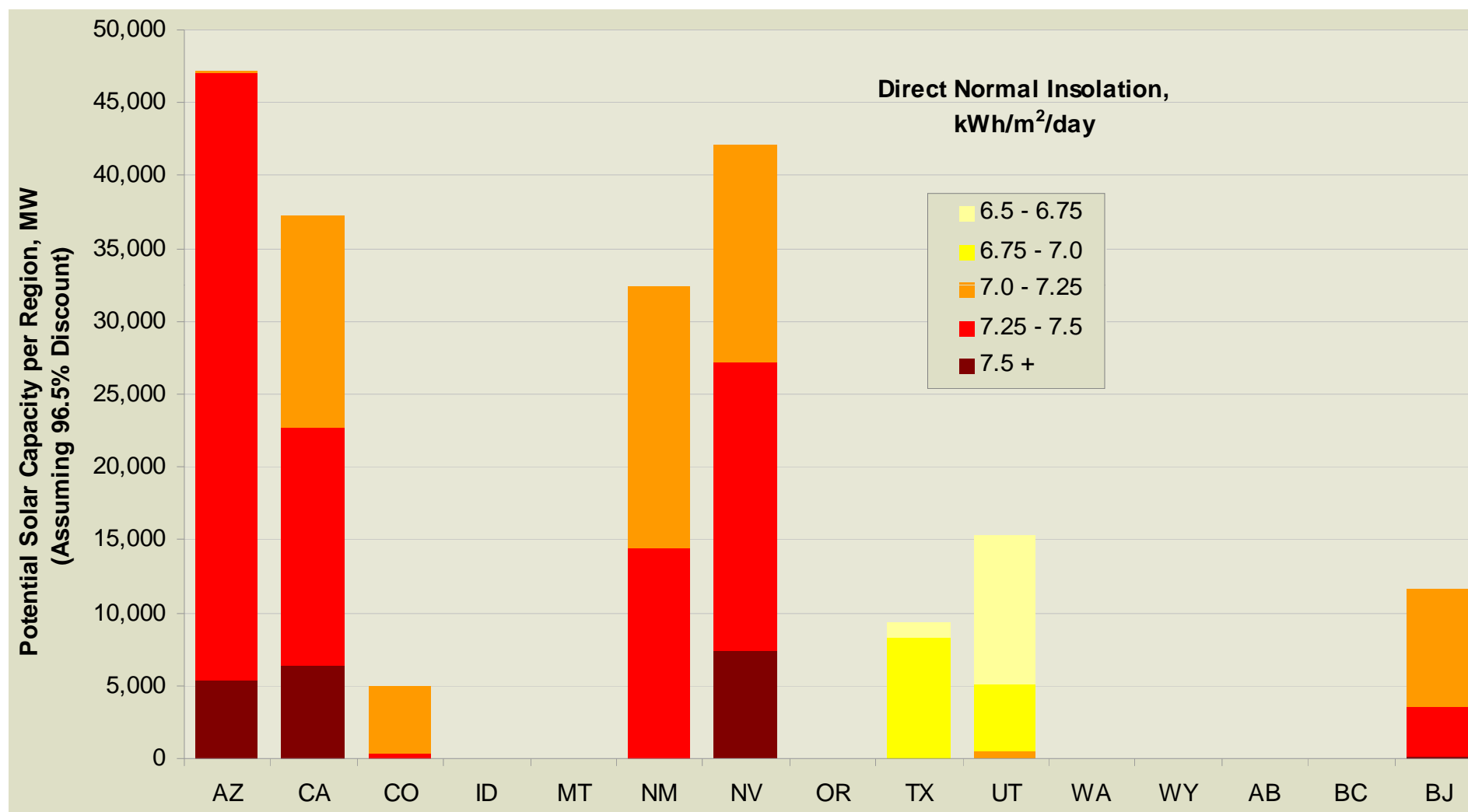
- Estimates resource potential at a particular price point in each "hub"



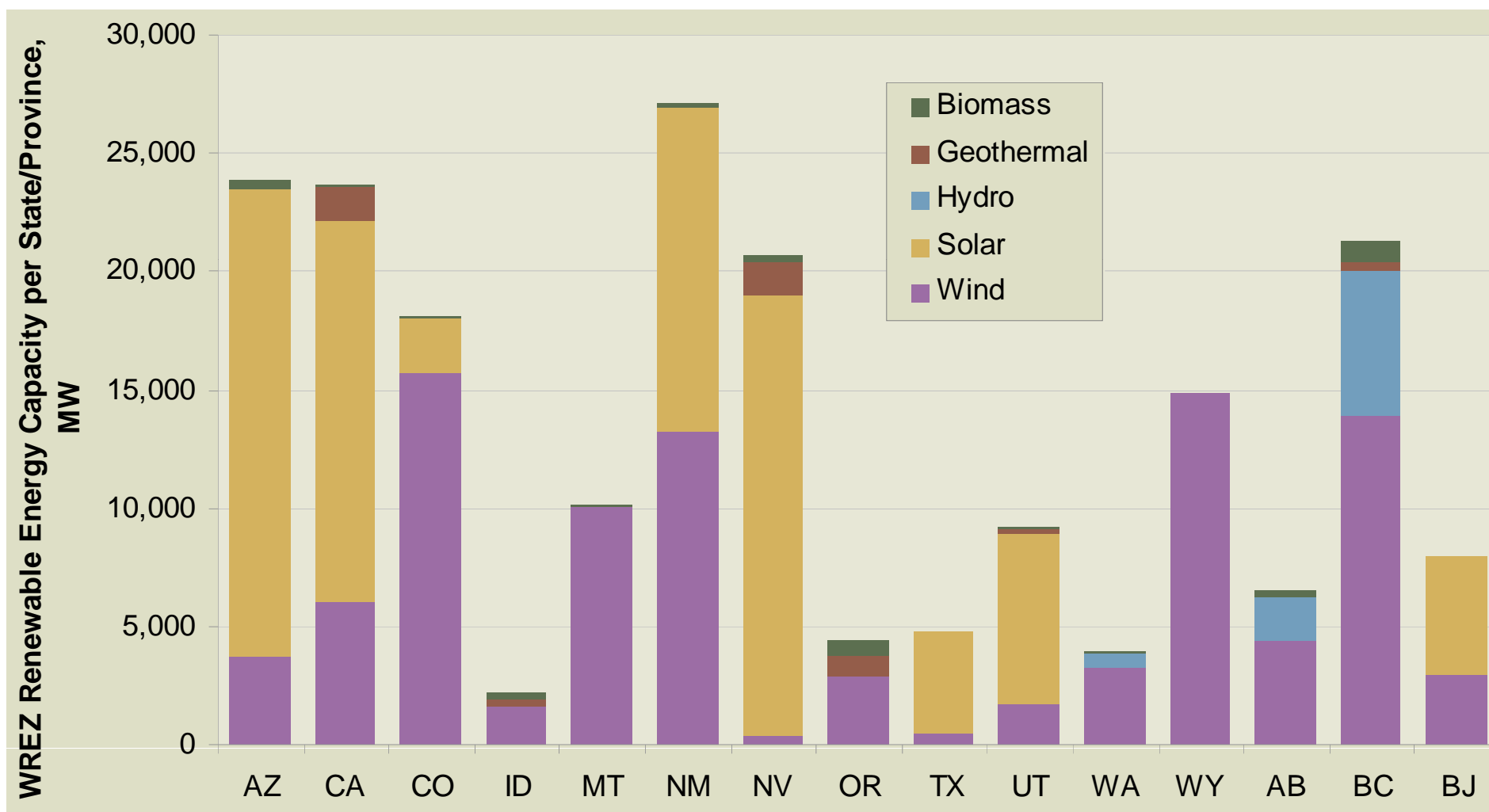
Wind Resources in Hubs (MW)



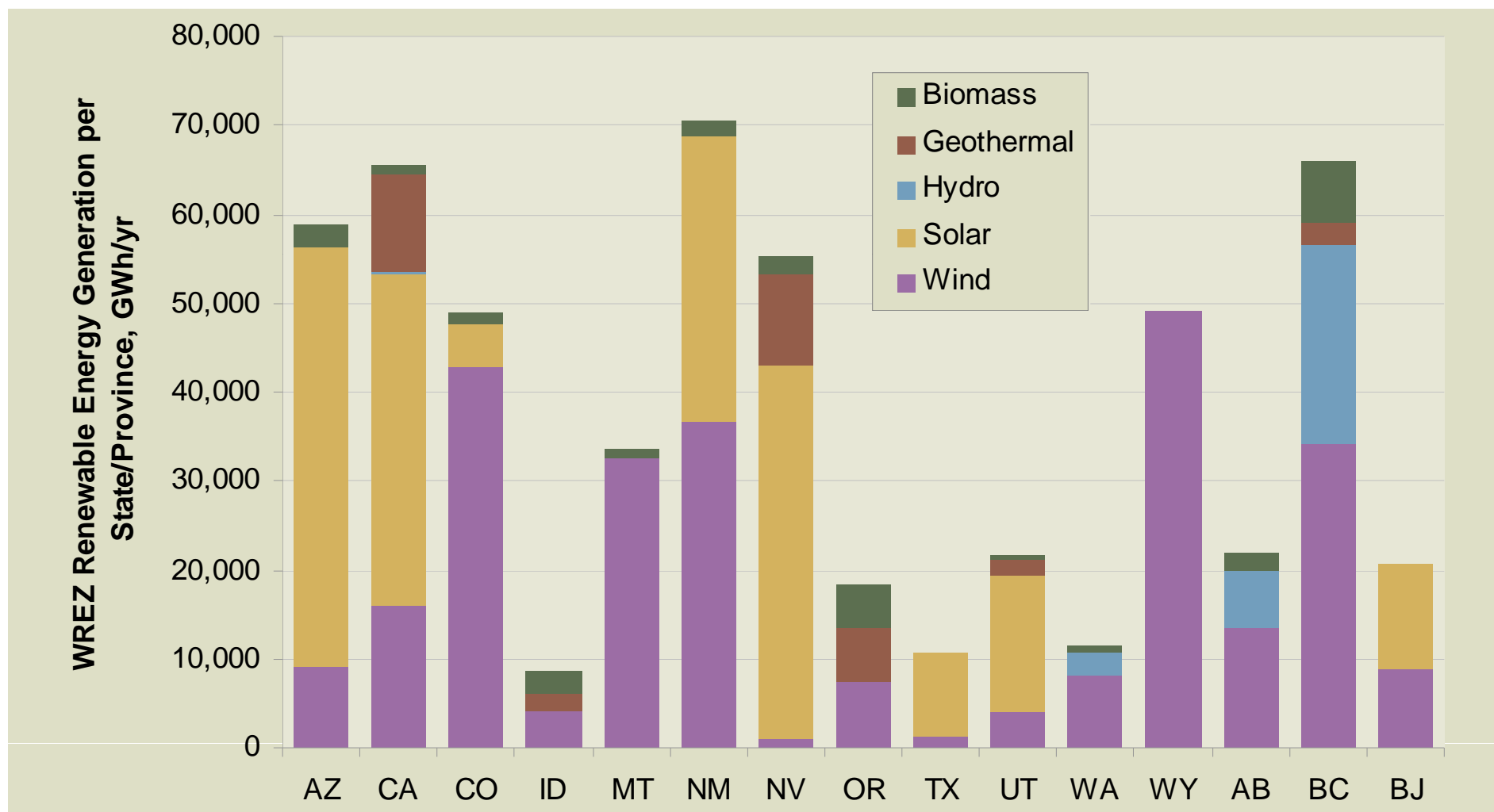
Solar Resources in Hubs (MW)



MW – All Resources (within hubs)



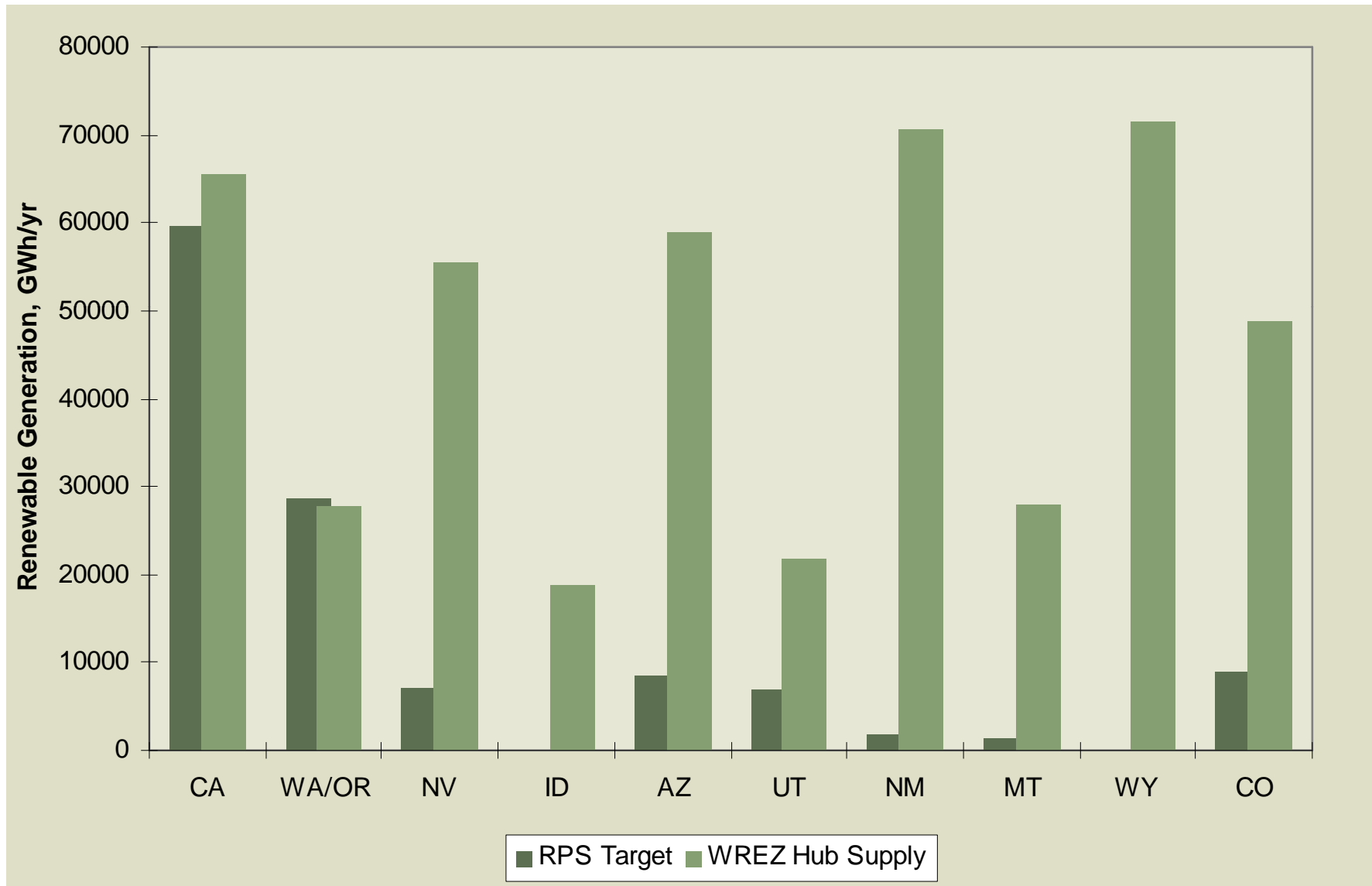
GWh/yr – All Resources (within hubs)



WREZ Resource Assessment Conclusions for RETI

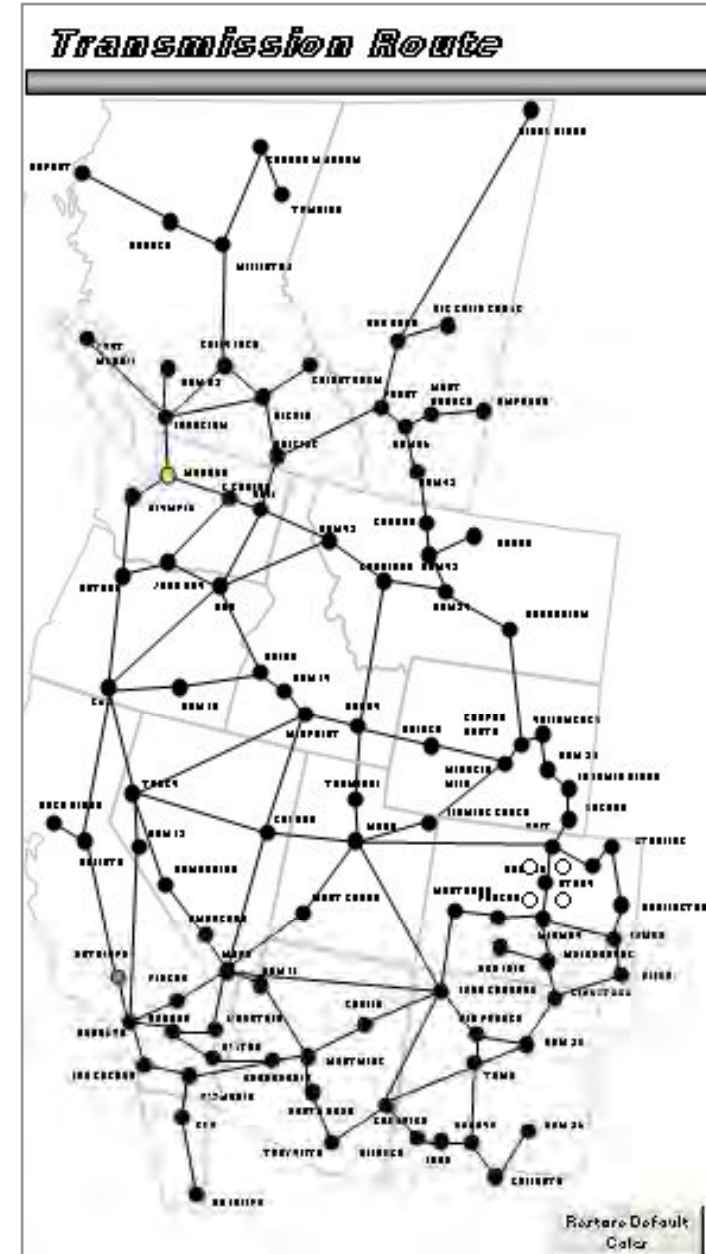
- There is significantly more developable renewable energy across the WECC than there is RPS demand
- Throughout the WECC there is a large amount of high quality developable renewable energy resources
- WREZ has quantified and estimated the cost of these resources

Comparison of WREZ resources and RPS Targets

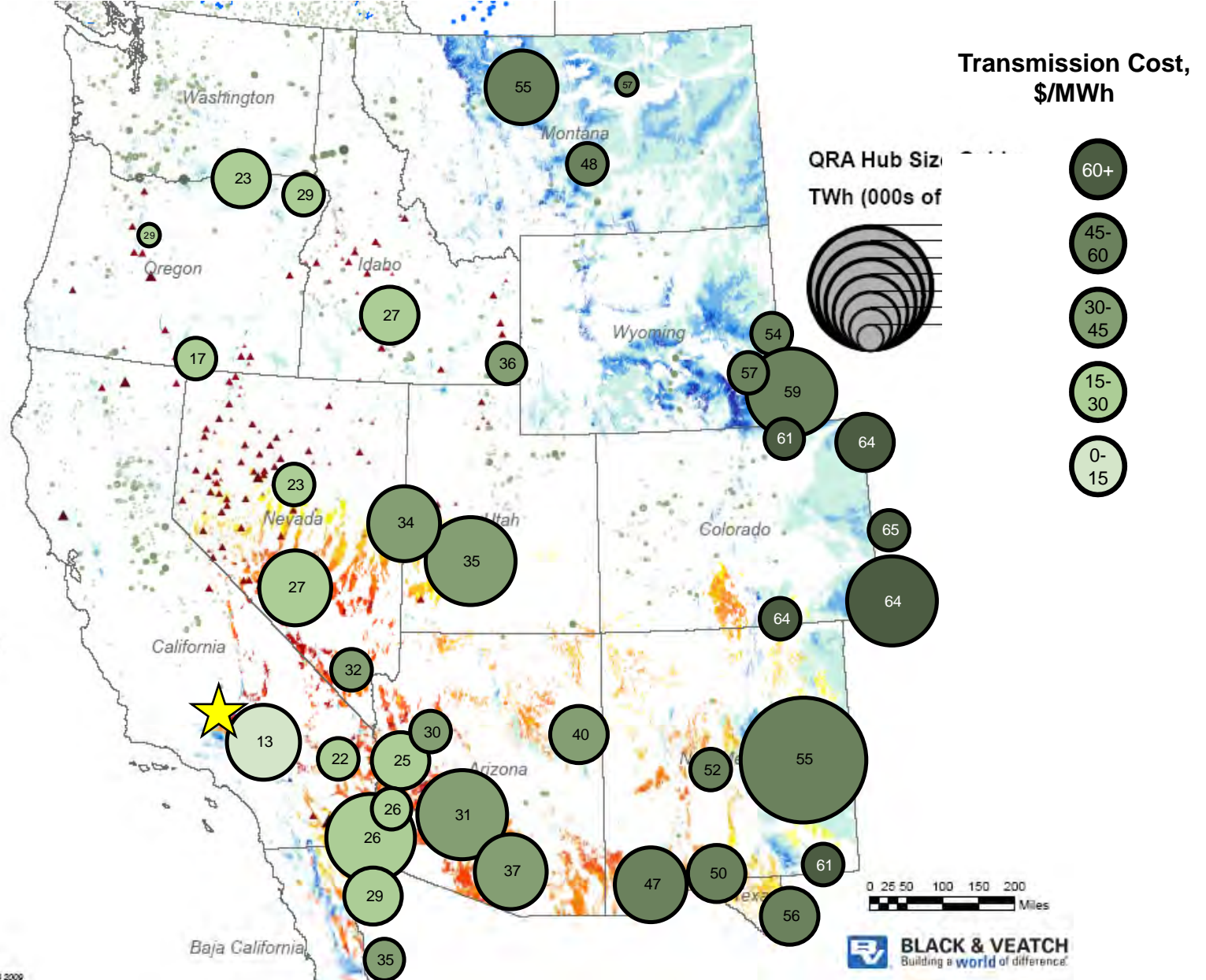


WREZ Generation and Transmission Model

- Models cost of delivering energy from any resource area to each load center
- Models major transmission paths, not specific transmission lines
- Assumes all incremental transmission – default is 500 kV (user may change)



WREZ Trans- mission Costs (\$/MWh) from QRAs to California



Created by Josh Finn, Orsén Holmgren and Ryan Pietka, June 4 2009

RETI Out of State Analysis vs. WREZ

	RETI 1B Out of State Analysis	WGA WREZ Analysis
Geographic scope	OR, WA, parts of AZ, BJ, BC, NV	Entire WECC
Resource assessment	Pre-id'ed projects or high-level resource assessment (no resource locations)	Screening level assessment with general resource locations
Transmission access methodology	Piecemeal, assumes resources utilize existing OR planned infrastructure	Standardized, assumes all new lines
Transmission economics	Piecemeal, assessed by location or proposed line	Standardized, applies standard assumptions across the WECC

Putting WREZ to Work for RETI – Potential Options

- Consider substitution of WREZ OOS results for RETI in Oregon, Washington, Arizona, Nevada, and British Columbia
- Consider additional states in RETI using WREZ data set (e.g. include Wyoming and Montana)
- Evaluate possibility to merge some OOS resource areas into adjacent CA CREZs (e.g., southern NV into Mountain Pass)
- Update transmission costs for out of state resources

Baja Resource Assessment

- Conduct more detailed assessment of Baja wind to determine capacity
- Split wind resource to deliver at Imperial and ECO substations
- Develop transmission assumptions to interconnect to CA grid